Defining Classes

Classes, Fields, Constructors

SoftUni Team

Technical Trainers

Software University

http://softuni.bg

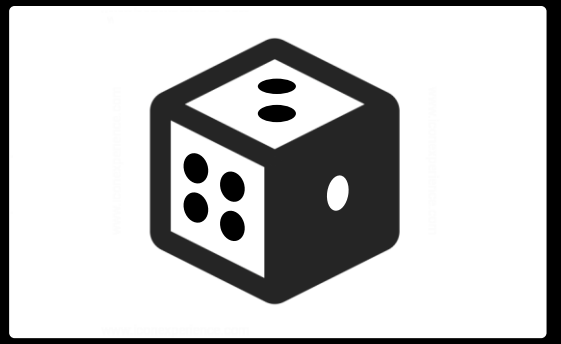

Table of Contents

SoftUni Foundation

Questions

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#JavaFundamentals

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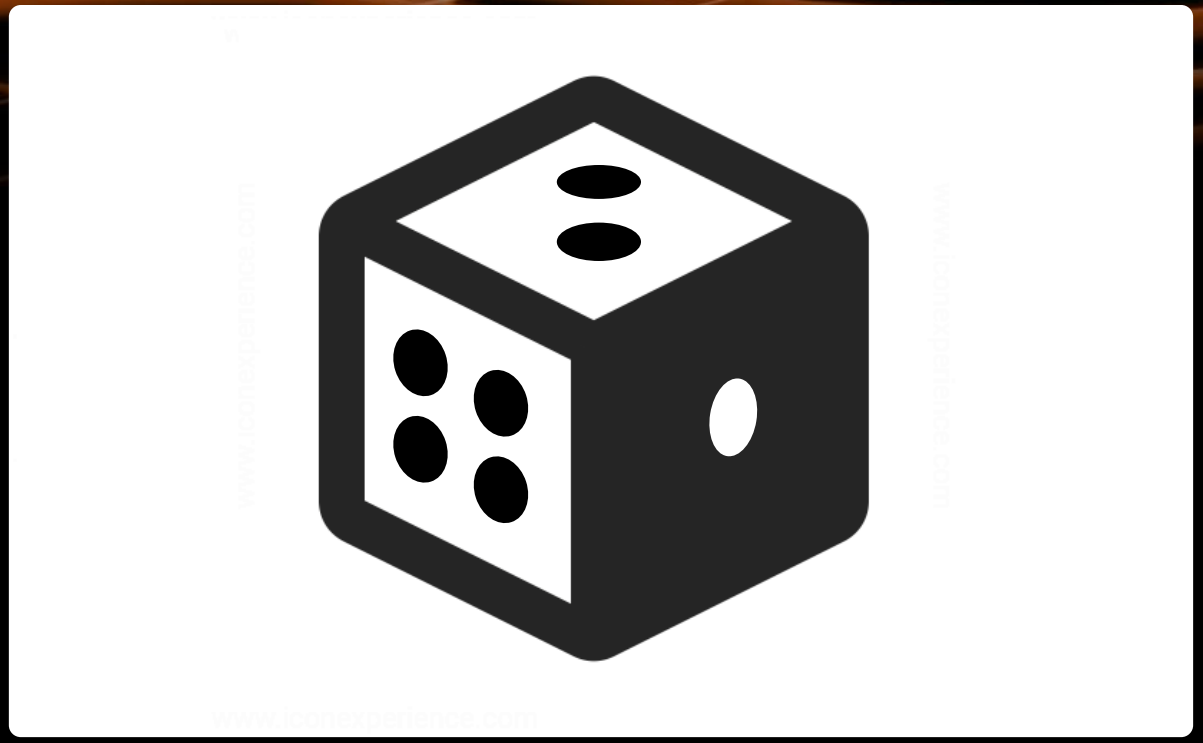

Abstract Data Type

Hide Details from the Client

Abstract Data Type

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- Data type whose **representation** is **hidden** from the client

```
String ADT – indexed sequence of chars:

          String()
       int length()
      char charAt(int index)
   boolean isEmpty()

// many others…
```

ADTs are defined by their usage

Abstract Data Type (2)

- You **don't need** to know the **implementation** to use an ADT

```
Dog:
        Dog()
 String getName()
   void bark()
   void sleep()
```

```
Computer:
          Computer()
    void turnOn()
    void turnOff()
 String getSpecs()
```

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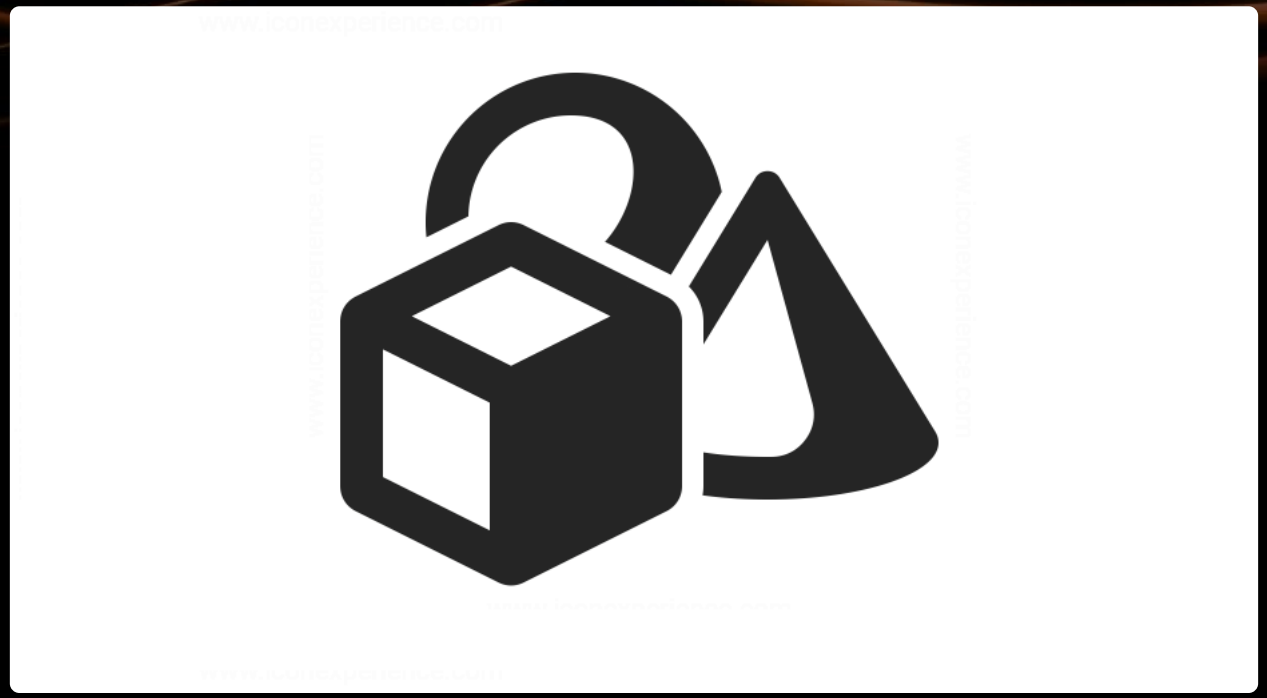


Defining Classes

Creating Class for an ADT

Defining Simple Classes

- Class is a **concrete implementation** of an ADT
- Classes provide **structure for describing and creating objects**

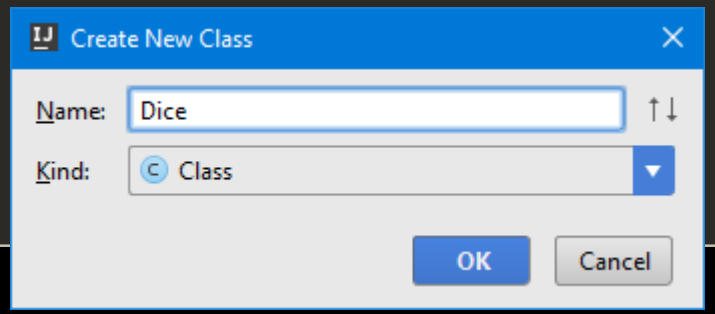
Keyword

Class name

```
class Dice {
    ...
}
```

Class body

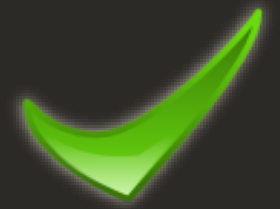
Class in a separate file



Naming Classes

- Classes should be **PascalCase**
- Use **descriptive nouns**
- **Avoid abbreviations** (except widely known, e.g. URL, HTTP, etc.)

```
class Dice { … }
class BankAccount { … }
class IntegerCalculator { … }
```



```
class TPMF { … }
class bankaccount { … }
class intcalc { … }
```

Class Members

- Class is made up of **state** and **behavior**
- Fields **store state**
- Methods **describe behaviour**

```
class Dice {
  int sides;
  String type;

  void roll(){ … }
}
```

Fields

Method

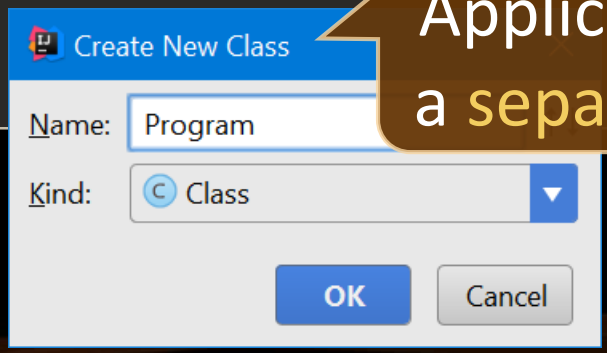
Creating an Object

- A class can have **many instances** (objects)

```
class Program {
  public static void main(String[] args) {
    Dice diceD6 = new Dice();
    Dice diceD8 = new Dice();
  }
}
```

Variable stores a **reference**

Use the **new** keyword

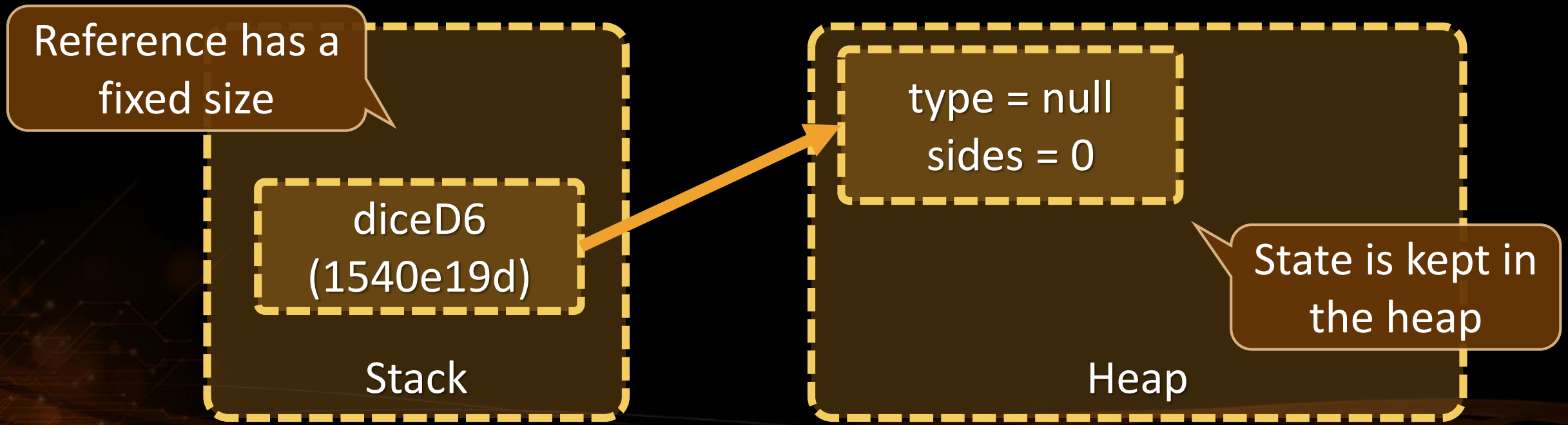


Application in a separate file

Object Reference

- Declaring a variable creates a **reference** in the stack
- **new** keyword allocates memory on the heap

```
Dice diceD6 = new Dice();
```



Classes vs. Objects

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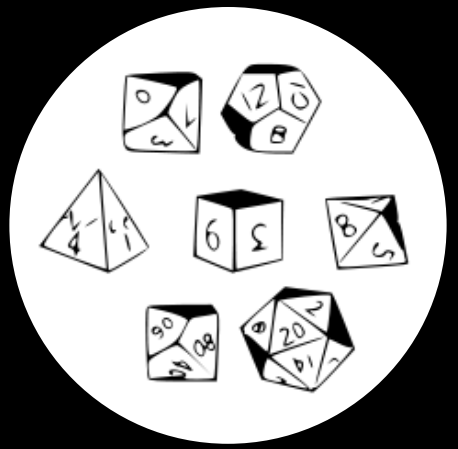
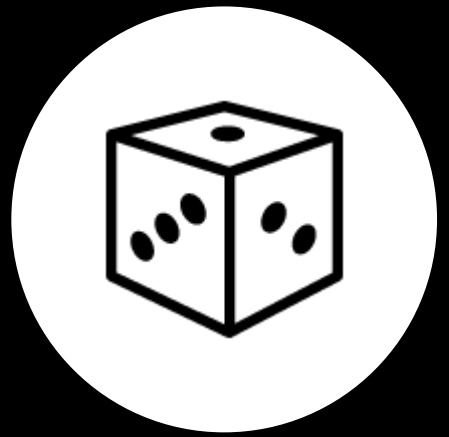
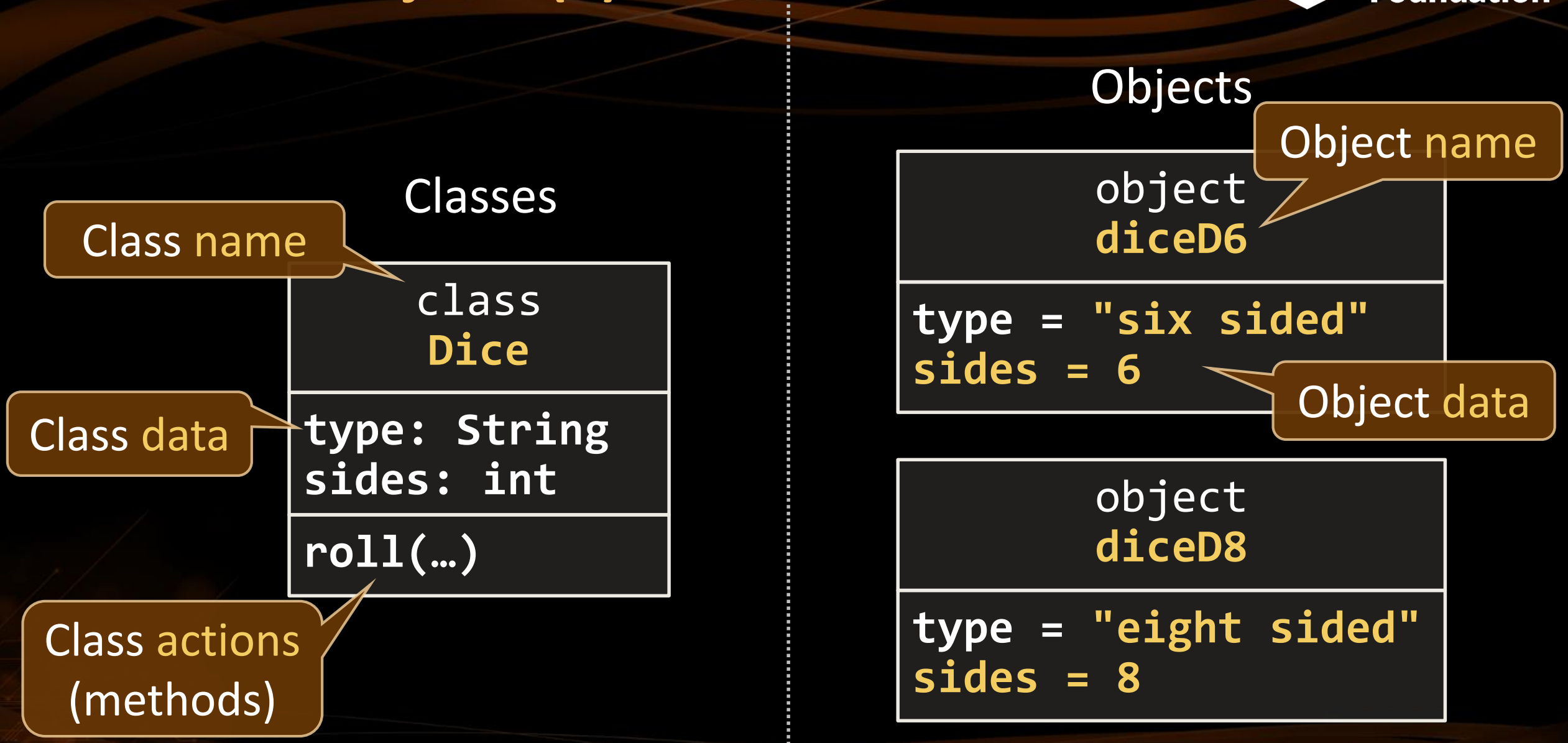
- Classes provide **structure** for describing and creating objects
- An **object** is a **single instance of a class**





Dice ADT → Dice (Class) → D6 Dice (Object)

Classes vs. Objects (2)



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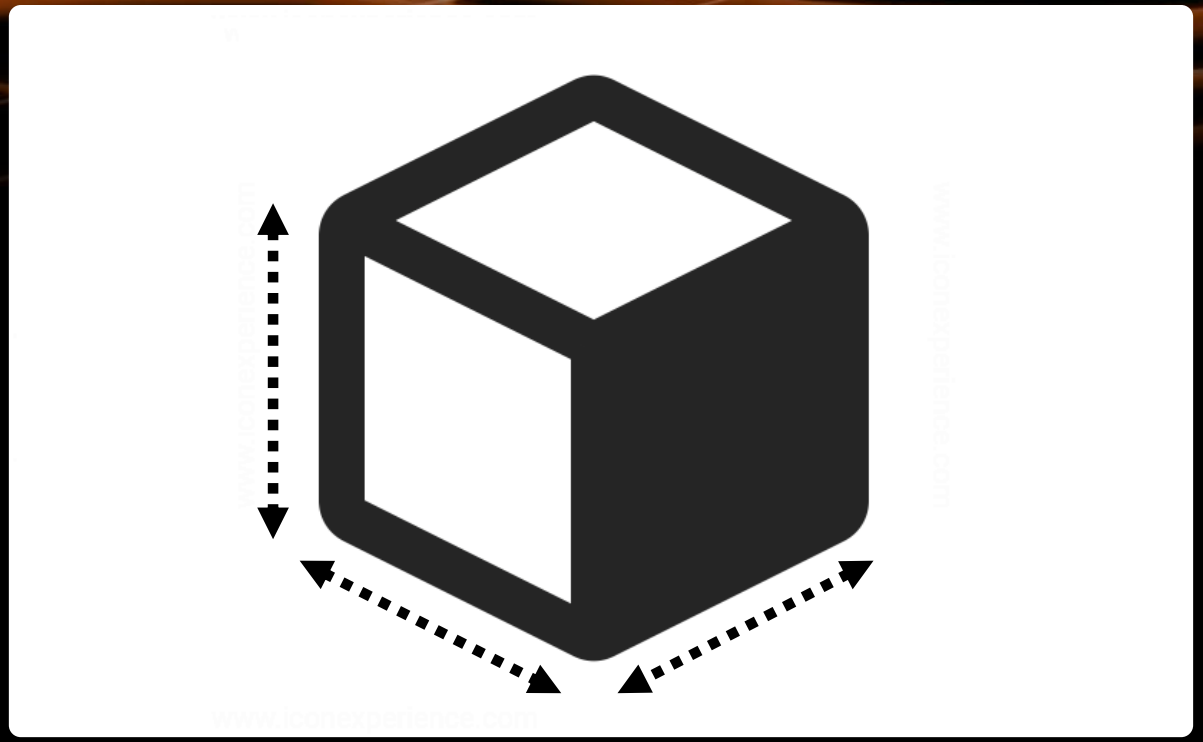


Class Data

Storing Data Inside a Class

Fields

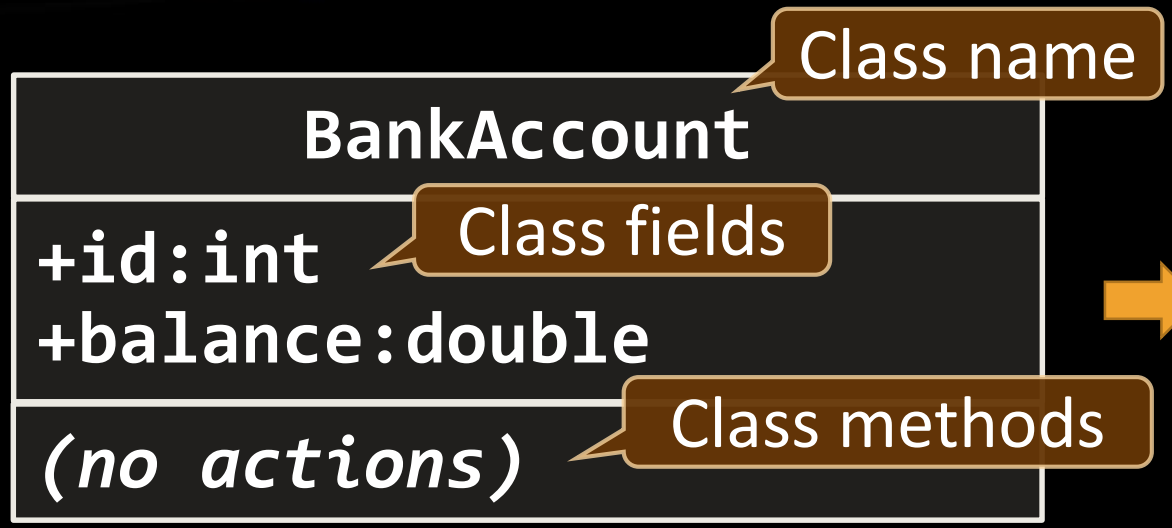
- Class fields have type and name

```
class Dice {
   String type;
   int sides;
   int[] rollFrequency;
   Person owner;
   …
}
```

Fields can be of any type

Problem: Define Class Bank Account

- Create a class **BankAccount**




```
public class Main {
    public static void main(String[] args) {
        BankAccount acc = new BankAccount();

        acc.id = 1;
        acc.balance = 15;

        System.out.printf(
                "Account ID%d, balance %.2f",
                acc.id,
                acc.balance
        );
    }
}
```

- Ensure proper naming!

Solution: Define Class Bank Account

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```
public class BankAccount {
   int id;
   double balance;
}
```

Modifiers

- Classes and class members **have modifiers**
- Modifiers **define visibility**

Class modifier

```
public class Dice {
  private int sides;
  public void roll(int amount);
}
```

Fields should always be private!

Member modifier

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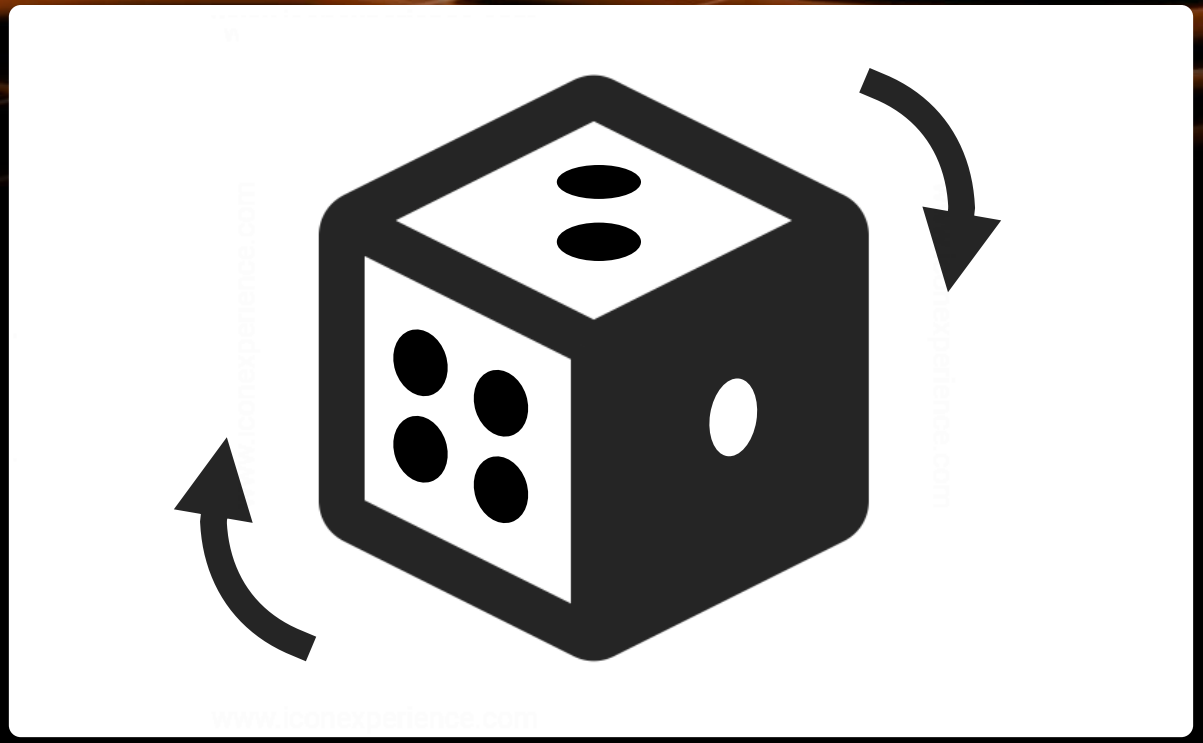


Methods

Defining a Class' Behaviour

Methods

- Store **executable code** (algorithm) that manipulate state

```
class Dice {
  private int sides;

  public int roll() {
    Random rnd = new Random();
    int rollResult = nextInt(this.sides) + 1;
    return rollResult;
  }
}
```

this points to the current instance

Getters and Setters

- Used to create **accessors** and **mutators** (**getters** and **setters**)

```
class Dice {
  private int sides;
  public int getSides() {
    return this.sides;
  }

  public void setSides(int sides) {
    this.sides = sides;
  }
}
```

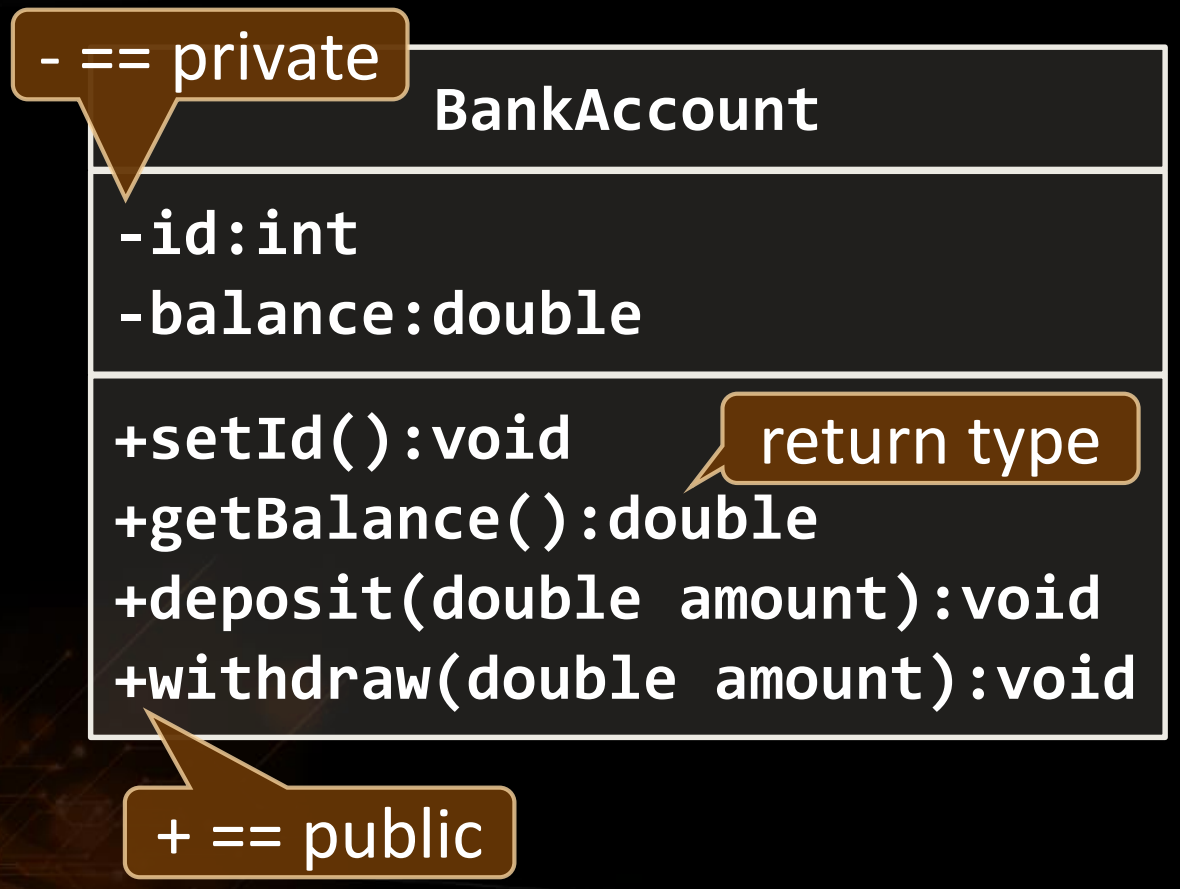
Field is hidden

Getter provides access to field

Setter provide field change

Problem: Getters and Setters

- Create a class **BankAccount**




```
public class Main {
    public static void main(String[] args) {

        BankAccount acc = new BankAccount();

        acc.setId(1);
        acc.deposit(15);
        acc.withdraw(5);

        System.out.printf(
                "Account %s, balance %.2f",
                acc,
                acc.getBalance()
        );
    }
}
```

Override toString()

Solution: Getters and Setters

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```
public class BankAccount {
   private int id;
   private double balance;

   public void setId(int id) { this.id = id; }
   public double getBalance() { return this.balance; }
   public void deposit(double amount) { //TODO: }
   public void withdraw(double amount) { //TODO: }
   @Override
   public String toString() { return "ID" + this.id; }
}
```

Problem: Test Client

- Create a **test client** that tests your **BankAccount** class
- Support commands:
  - **Create {Id}**
  - **Deposit {Id} {Amount}**
  - **Withdraw {Id} {Amount}**
  - **Print {Id}**
  - **End**

```
Create 1
Create 1
Deposit 1 20
Withdraw 1 30
Withdraw 1 10
Print 1
End
```

Exsisting account

Insufficient balance

```
Account already exists
Insufficient balance
Account ID1, balance 10.00
```

.2f

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

Solution: Test Client

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```
Scanner scanner = new Scanner(System.in);
HashMap<Integer, BankAccount> accounts = new HashMap<>();

String command = scanner.nextLine();
while (!command.equals("End")) {
  // TODO: Get command arguments (cmdArgs[])
  switch (cmdType) {
    case "Crete": execCreate(cmdArgs, accounts); break;
    case "Deposit": execDeposit(cmdArgs, accounts); break;
    case "Withdraw": execWithdraw(cmdArgs, accounts); break;
    case "Print": execPrint(cmdArgs, accounts); break;
  }
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

Solution: Test Client (2)

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```
// Account creation
int id = Integer.valueOf(cmdArgs[1]);
if (accounts.containsKey(id)) {
  System.out.println("Account already exists");
} else {
  BankAccount account = new BankAccount();
  account.setId(id);
  accounts.put(id, account);
}

// TODO: Implement other commands…
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

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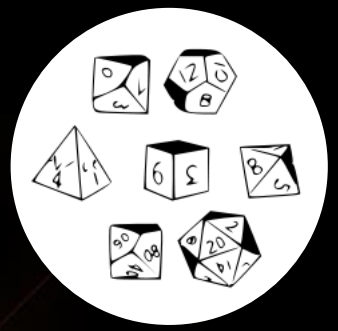

Defining Classes

Live Exercises in Class (Lab)

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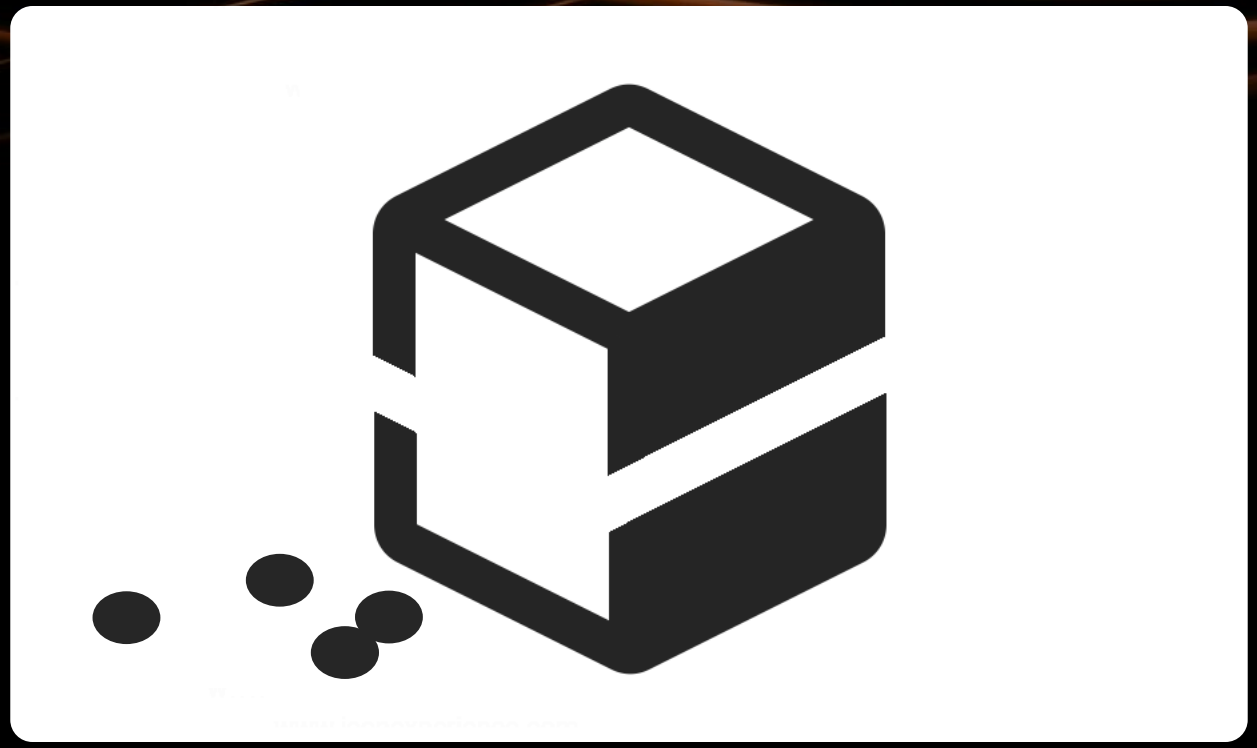


Constructors

Object Initialization

Constructors

- Special methods, executed during object creation

```
class Dice {
  int sides;

  public Dice() {
    this.sides = 6;
  }
}
```

Overloading default constructor

Constructors (2)

- You can have multiple constructors in the same class

```
class Dice {
  int sides;

  public Dice() {
    this.sides = 6;
  }

  public Dice(int sides) {
    this.sides = sides;
  }
}
```

Constructor without parameters

Constructor with parameters

Object Initial State

- Constructors **set object's initial state**

```
class Dice {
  int sides;
  int[] rollFrequency;

  public Dice(int sides) {
    this.sides = sides;
    this.rollFrequency = new int[sides];
  }
}
```

Always ensure correct state

Constructor Chaining

- Constructors can call each other

```
class Dice {
  int sides;
  public Dice() {
    this(6);
  }

  public Dice(int sides) {
    this.sides = sides;
  }
}
```

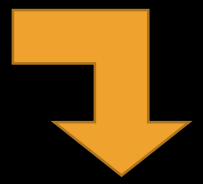
Calls constructor with parameters

6 should be declared in a final variable

Problem: Define Person Class

- Create a class **Person**

Person
-name:String -age:int -accounts:List<BankAccount>
+Person(String name, int age) +Person(String name, int age, List<BankAccount> accounts) +getBalance():double



```
Person andy =
    new Person("Andy Price", 32);

Person greg =
    new Person("Greg Mills",
            22, new ArrayList<>());
```

Solution: Define Person Class

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```
public Person(String name, int age) {
  this.name = name;
  this.age = age;
  this.accounts = new ArrayList<>();
}

public Person(String name, int age, List<BankAccount> accs) {
  this.name = name;
  this.age = age;
  this.accounts = accs;
}
```

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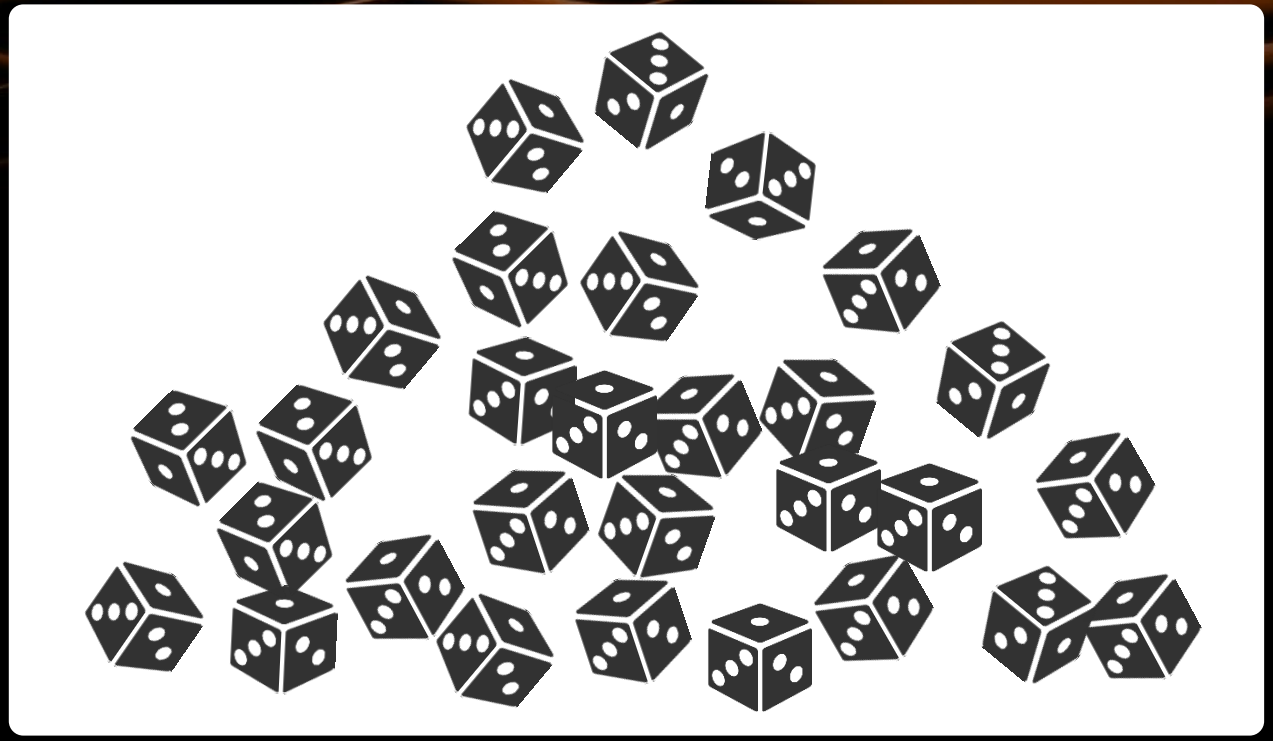

Static Members

Members Common for the Class

Static Members

- Static members are **shared class-wide**

```
class BankAccount {
  private static int accountsCount;

  public BankAccount() {
    accountsCount++;
  }
  …
}
```

Static Members (2)

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- Static members are **shared class-wide**

```
class BankAccount {
  private static double interestRate;

  public static void setInterestRate(
      double rate) {
    interestRate = rate;
  }
  …
}
```

Accessing Static Members

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- Access static members **through the class name**
- You don't need an instance

```
class Program {
  public static void main(String[] args) {
    BankAccount.setInterestRate(2.2);
  }
}
```

Sets the rate for all bank accounts

Problem: Static Id and Rate

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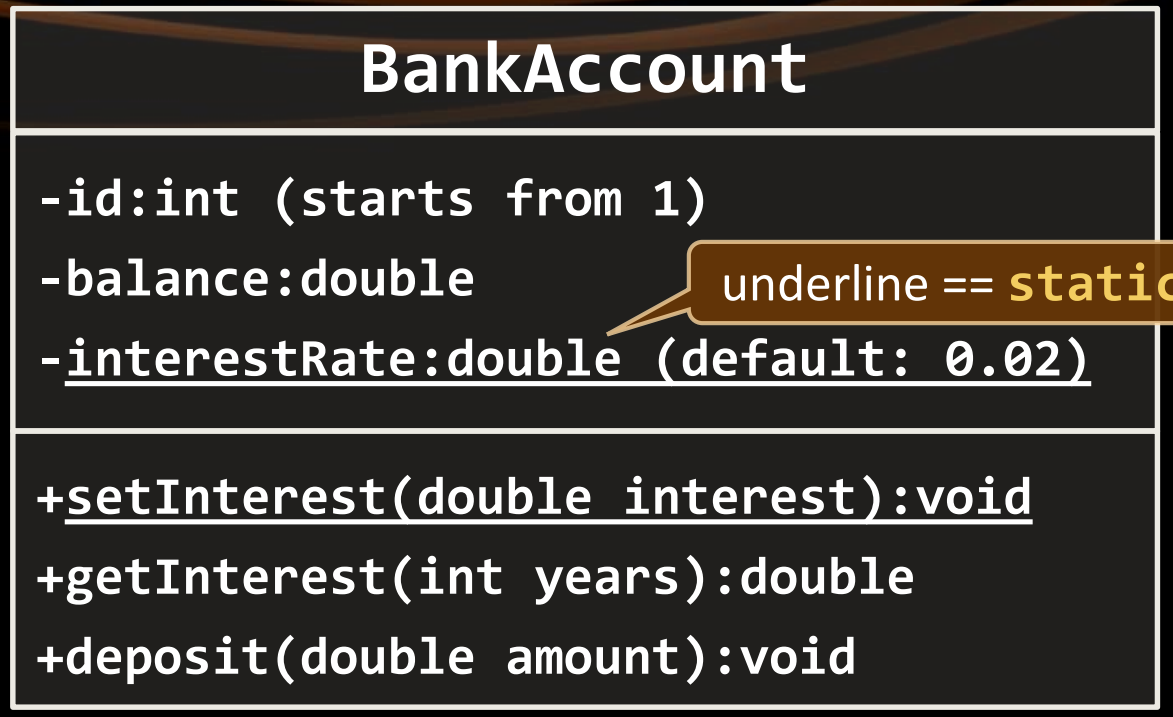
- Create a class **BankAccount**
- Support **commands**:
  - **Create**
  - **Deposit** {ID} {Amount}
  - **SetInterest** {Interest}
  - **GetInterest** {ID} {Years}
  - **End**




```
Create
Deposit 1 20
GetInterest 1 10
End
```

```
Account ID1 Created
Deposited 20 to ID1
4.00
```

(20 * 0.02) * 10

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

Solution: Bank Account

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```
public class BankAccount {
  private final static double DEFAULT_INTEREST = 0.02;

  private static double rate = DEFAULT_INTEREST;
  private static int bankAccountsCount;

  private int id;
  private double balance;

  // constructor and methods…
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

Solution: Bank Account (2)

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```
public class BankAccount {
  // continued…

  public BankAccount() {
        this.id = ++bankAccountsCount;
  }

  public static void setInterest(double interest) {
    rate = interest;
  }

  // TODO: override toString()
  // TODO: void deposit(double amount)
  // TODO: double getInterest(int years)
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

Solution: Bank Account (2)

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```
HashMap<String, BankAccount> bankAccounts = new HashMap<>();
while (!command.equals("End")) {
  // TODO: Get command args
  switch (cmdType) {
    case "Create": // TODO
    case "Deposit": // TODO
    case "SetInterest": // TODO
    case "GetInterest": // TODO

  // TODO: Read command
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/474#0

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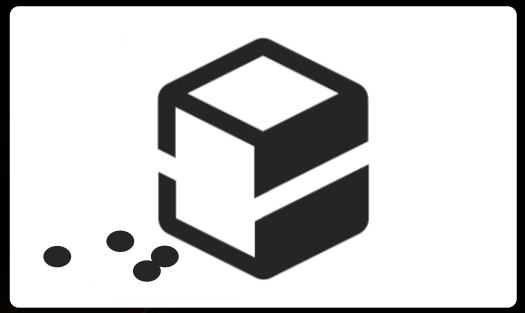

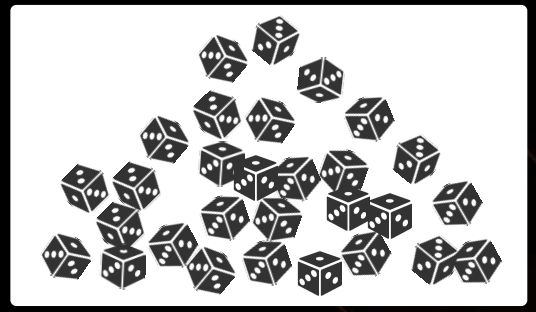

Constructors and Static Members

Live Exercises in Class (Lab)

Summary

- Classes define specific **structure** for objects
  - Objects are particular **instances of a class**
- Classes define **fields**, **methods**, **constructors** and other members
- Constructors are **invoked** when creating **new class instances**
- Constructors **initialize** the **object's initial state**

Defining Classes

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